BOOK OF ABSTRACTS

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P68. Simultaneous removal of *o*- and *p*-nitrophenol from contaminated water by wet peroxide oxidation using carbon-coated magnetic ferrite as catalyst

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Groundwater is the most common source of drinking water worldwide and is currently facing contamination problems with the discharge of pollutants into aquatic systems through different means, namely through municipal, industrial and agricultural activities. Contaminants, such as herbicides, pharmaceuticals, phenolic compounds and personal care products are not removed by conventional treatments from wastewater treatment plants, leading to their accumulation in the environment. In this regard, *o*-nitrophenol (*o*-NP) and *p*-nitrophenol (*p*-NP), commonly used as raw materials in chemical and pharmaceutical engineering, represent a severe risk to humans and aquatic life, leading to the necessity to properly treat wastewaters containing these contaminants before discharge into the aquatic environment.

Catalytic wet peroxide oxidation (CWPO) showed promising results for removing nitrophenols from wastewater in previous works. In this technology, H_2O_2 is used as an oxidant, and its interaction with a suitable catalyst leads to the formation of hydroxyl radicals under determined conditions already established in literature (pH and temperature have a strong influence) [1]. Typical catalysts employed have a transition metal in its structure. Carbon-based catalysts also have activity in this technology, mostly ascribed to the electronic properties of the carbonaceous surface. Furthermore, carbon-coated metal oxide materials (hybrid) have also demonstrated potential applications in CWPO. Those structures combine carbon and metal activities with the advantage of protecting the metal core from leaching, increasing the efficiency and stability of the catalysts.

In this work, carbon-based magnetic particles were prepared by carbon coating achieved via resorcinol-formaldehyde-TEOS ($CoFe_2O_4$@C) reaction, as described in previous works [2]. Cobalt ferrite was used as magnetic core. The metal oxide was synthesized by a green method using tangerine peel extract as the reducing agent for the co-precipitation of the $CoFe_2O_4$ nuclei. Bare core ($CoFe_2O_4$) and coated material were used to remove a simulated contaminated water matrix containing *o*- and *p*-nitrophenol.

Removal of the pollutants by adsorption reached 3.1 and 5.6% after 8 h, respectively for *o*- and *p*-NP, using $CoFe_2O_4$ as adsorbent and 6.4 and 9.1% for *o*- and *p*-NP, using $CoFe_2O_4$@C. The oxidation results shown in Figure 1 demonstrate that the carbon-coated catalyst presents the best performance, increasing the removal of *o*-NP by 17.7%, *p*-NP by 10.1% and H_2O_2 decomposition by 35.8% compared with the bare core after 8 h. The higher activity observed for this material can be ascribed to the activity of the carbon surface from $CoFe_2O_4$@C. The results obtained show that oxidation is the driving factor for the removal of the pollutants during the oxidation reactions. In addition, increased adsorption and pollutant removal need further investigation to understand if the degradation was also increased due to changes in lipophilicity with the carbon coating by changing catalyst's affinity with the pollutant. To conclude, the system presented here represents a very promising alternative for cleaning streams contaminated with *o*- and *p*-nitrophenol.
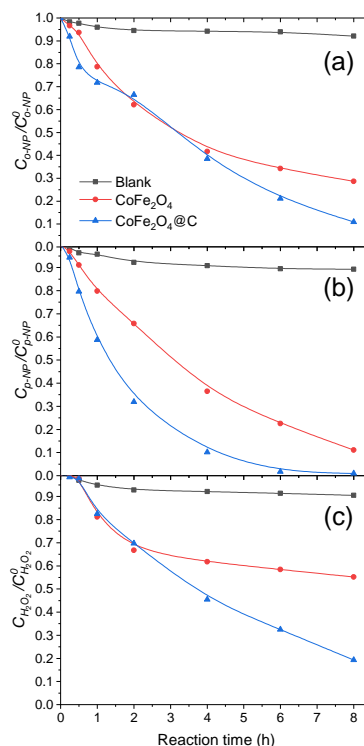

Figure 1. Concentrations of (a) *o*-NP, (b) *p*-NP, and (c) H_2O_2, throughout oxidation reactions. Lines are only used to guide reading the removal trends. Operating conditions: 80 °C, pH 3.5, $C^0_{o\text{-}NP} = C^0_{p\text{-}NP} = 50$ mg·L^{-1}, $C^0_{H_2O_2} = 696$ mg·L^{-1}, $C_{cat} = 2.5$ g·L^{-1}.

[1] J. L. Diaz de Tuesta *et al.*, "The pH effect on the kinetics of 4-nitrophenol removal by CWPO with doped carbon black catalysts," *Catal. Today*, vol. 356, no. August 2019, pp. 216–225, 2020, doi: 10.1016/j.cattod.2019.08.033.

[2] R. O. Rodrigues *et al.*, "Multifunctional graphene-based magnetic nanocarriers for combined hyperthermia and dual stimuli-responsive drug delivery," *Mater. Sci. Eng. C*, vol. 93, no. July, pp. 206–217, 2018, doi: 10.1016/j.msec.2018.07.060.